

On page 30, line 6, after "optic" insert --704--.

On page 30, line 7, after "turner" insert --708--.

On page 30, line 8, after "patient" insert --706--.

On page 30, line 8, after "optic" insert --710--.

On page 30, line 9, after "optic" insert --710--.

IN THE DRAWINGS:

Enclosed is a copy of a new informal drawing Fig. 7. This figure is added solely because of the Examiner's objection under 37 CFR 1.83(a) requiring that the set up of claim 4 must be shown.

IN THE CLAIMS:

Please amend the claims as follows. For the Examiner's convenience, all pending claims are reproduced below.

- 1                   1.       Previously canceled.
- 1                   2.       (Unchanged) An apparatus for efficiently deflecting light from an
- 2                   optical fiber around a corner, comprising:
- 3                         a first port adapted to be coupled to said optical fiber and to receive light with
- 4                         divergence angles of less than 90 degrees from the axis of said optical fiber;
- 5                         a non-imaging optical waveguide, connected to said first port, and adapted to
- 6                         direct light around said corner;
- 7                         a second port connected to said non-imaging optical waveguide; and
- 8                         a non-imaging optical concentrator for delivering a beam of light having half-
- 9                         angle divergence of 90 degrees, connected between said optical fiber and said first port.
- 1                   3.       (Unchanged) The apparatus of claim 2 further comprising:
- 2                         a second non-imaging optical concentrator, its high-divergence side connected
- 3                         to said second port.

1                   4.       (Unchanged) An apparatus for efficiently deflecting light from an  
2 optical fiber around a corner, comprising:  
3                   a first port adapted to be coupled to said optical fiber and to receive light with  
4 divergence angles of less than 90 degrees from the axis of said optical fiber;  
5                   a non-imaging optical waveguide, connected to said first port, and adapted to  
6 direct light around said corner;  
7                   a second port connected to said non-imaging optical waveguide; wherein said  
8 second port is adapted to direct light from said optical fiber to a patient, and further  
9 comprising:  
10                  a third port adapted to be coupled to a second optical fiber and direct light to  
11 said second optical fiber with divergence angles of less than 90 degrees from the axis of  
12 said second optical fiber;  
13                  a second non-imaging optical waveguide, connected to said third port, and  
14 adapted to direct light around a corner; and  
15                  a fourth port connected to said second non-imaging optical waveguide and  
16 configured to receive reflected light from said patient.

1                   5.       (Unchanged) The apparatus of claim 2 wherein said non-imaging  
2 optical waveguide comprises a curved reflective segment connected between said first  
3 port and said second port.

1                   6.       (Unchanged) The apparatus of claim 5 wherein, in any section parallel  
2 to the plane of said corner, said curved reflective section appears as an arc of a circle.

1                   7.       (Unchanged) The apparatus of claim 5 wherein said curved reflective  
2 segment is an inner curve, further comprising a second curved reflective segment as an  
3 outer curve, which is connected between said first port and said second port.

886  
C2  
1                   8.       (Three Times Amended) An apparatus for efficiently deflecting light  
2 from an optical fiber around a corner, comprising;

3 a first port adapted to be coupled to said optical fiber and to receive light with  
4 divergence angles of less than 90 degrees from the axis of said optical fiber;

5 a non-imaging optical waveguide, connected to said first port, and adapted to  
6 direct light around said corner;

7 a second port connected to said non-imaging optical waveguide;

8 wherein every section parallel to the plane of [the bend] said corner is identical,  
9 and upper and lower surfaces of said non-imaging optical waveguide are planar  
10 reflective surfaces.

1 ~~7~~ 9. (Unchanged) The apparatus of claim 6 wherein said arc has a radius of  
2 the width of said first port, and a center at an end of said first port at an inside of said  
3 turn around said corner.

1 10. (Unchanged) The apparatus of claim 9 wherein said arc extends to said  
2 second port at an angle of 60 degrees from a plane of said first port.

1 11. (Unchanged) The apparatus of claim 9 wherein said arc extends to said  
2 second port at an angle not exceeding  $(90^\circ + \phi)/2$ , where  $\phi$  is the maximum half-angular  
3 divergence of rays entering said first port.

1 12. (Unchanged) An apparatus for efficiently deflecting light from an  
2 optical fiber around a corner, comprising:

3 a first port adapted to be coupled to said optical fiber and to receive light with  
4 divergence angles of less than 90 degrees from the axis of said optical fiber;

5 a non-imaging optical waveguide, connected to said first port, and adapted to  
6 direct light around said corner;

7 a second port connected to said non-imaging optical waveguide;

8 a non-imaging optical concentrator for delivering a beam of light having half-  
9 angle divergence of 90 degrees, connected between said optical fiber and said first port;  
10 and

11            wherein said non-imaging optical waveguide comprises a first curved reflective  
12            segment extending along an outside of a turn around of said corner, and a second  
13            curved reflective segment extending around an inside of said turn around said corner.

1            13.    (Unchanged) The apparatus of claim 12 wherein, in any section parallel  
2            to the plane of said corner, said first curved reflective segment appears as a section of a  
3            first ellipse and said second curved reflective segment appears as a section of a second  
4            ellipse.

1            3b E > 14.    (Unchanged) The apparatus of claim 13 wherein  
2            said first ellipse has foci at ends of said second curved reflective segment; and  
3            said second ellipse has foci at ends of said first curved reflective segment.

1            15.    (Unchanged) The apparatus of claim 14 wherein:  
2            every section parallel to the plane of said corner is identical, and  
3            upper and lower surfaces of said non-imaging optical waveguide are planar  
4            reflective surfaces.

1            16.    (Unchanged) The apparatus of claim 14 wherein:  
2            said non-imaging optical concentrator is of the 3D type, and  
3            in every section parallel to the plane of said corner, said first curved reflective  
4            segment is of such size as to contact the outer edge of said first port and said second  
5            curved reflective surface is of such size as to contact the inner edge of said first port.

1            17.    (Unchanged) An apparatus for efficiently deflecting light from an  
2            optical fiber around a corner, comprising:  
3            a first port adapted to be coupled to said optical fiber and to receive light with  
4            divergence angles of less than 90 degrees from the axis of said optical fiber;  
5            a non-imaging optical waveguide, connected to said first port, and adapted to  
6            direct light around said corner;  
7            a second port connected to said non-imaging optical waveguide;

wherein said non-imaging optical waveguide comprises:

a first reflective segment extending along an inside of a turn around said corner from said first port to said second port, such that in any section parallel to the plane of said corner, said first reflective segment appears as a straight line; and

a second reflective segment extending along an outside of said turn around said corner from said first port to said second port, such that in any section parallel to the plane of said corner, said second reflective segment appears as a curve comprising

a first parabolic segment extending from said first port,

an elliptical segment extending from said first parabolic segment, and

a second parabolic segment extending from said elliptical segment to said second port.

18. (Unchanged) The apparatus of claim 17 wherein:

every section parallel to the plane of said corner is identical, and

upper and lower surfaces of said non-imaging optical waveguide are planar reflective surfaces.

19. (Unchanged) The apparatus of claim 17 wherein:

said first port is circular in cross section, and

in every section parallel to the plane of said corner, said first curved reflective segment is of such size as to contact the outer edge of said first port and said second curved reflective surface is of such size as to contact the inner edge of said first port.

20. (Unchanged) The apparatus of claim 17 wherein said elliptical segment is so constructed that the slope of said elliptical segment is equal to slopes of said first and second parabolic segments at their respective points of intersection.

21. (Unchanged) The apparatus of claim 17 wherein said elliptical segment has foci at the ends of said first reflective segment.

1 ~~E~~ 22. (Unchanged) The apparatus of claim 17 wherein said first parabolic  
2 ~~and U~~ segment has a focus at an intersection of said planar reflective segment and said second  
3 port.

1 23. (Unchanged) The apparatus of claim 17 wherein said second parabolic  
2 segment has a focus at an intersection of said first reflective segment and said first port.

1 24. (Twice Amended) [The apparatus of claim 17] An apparatus for  
2 efficiently deflecting light from an optical fiber around a corner, comprising:  
3 a first port adapted to be coupled to said optical fiber and to receive light from  
4 the axis of said optical fiber;  
5 a non-imaging optical waveguide, connected to said first port, and adapted to  
6 direct light around said corner;  
7 a second port connected to said non-imaging optical waveguide;  
8 wherein said non-imaging optical waveguide comprises:  
9 a first reflective segment extending along an inside of a turn around said corner  
10 from said first port to said second port, such that in any section parallel to the plane of  
11 said corner, said first reflective segment appears as a straight line; and  
12 a second reflective segment extending along an outside of said turn around said  
13 corner from said first port to said second port, such that in any section parallel to the  
14 plane of said corner, said second reflective segment appears as a curve comprising  
15 a first parabolic segment extending from said first port,  
16 an elliptical segment extending from said first parabolic segment,  
17 a second parabolic segment extending from said elliptical segment to  
18 said second port, wherein said second port is at an angle of less than ninety degrees from said  
19 first port, and further comprising:  
20 a third port around a second corner from said second port;  
21 a third reflective segment extending along an inside of a turn around said  
22 second corner from said second port to said third port, such that in any section parallel  
23 to the plane of said corner, said third reflective segment appears as a straight line;

24 a fourth reflective segment extending along an outside of said turn around said  
25 second corner from said second port to said third port, such that in any section parallel  
26 to the plane of said corner, said fourth reflective segment appears as a curve  
27 comprising:  
28 a third parabolic segment extending from said second port,  
29 a second elliptical segment extending from said third parabolic segment,  
30 and  
31 a fourth parabolic segment extending from said second elliptical segment to said  
32 third port.

1 25. (Unchanged) An apparatus for efficiently deflecting light from an  
2 optical fiber around a corner, comprising:  
3 a first port adapted to be coupled to said optical fiber and to receive light with  
4 divergence angles of less than 90 degrees from the axis of said optical fiber;  
5 a non-imaging optical waveguide, connected to said first port, and adapted to  
6 direct light around said corner;  
7 a second port connected to said non-imaging optical waveguide;  
8 wherein said first and second ports are rectangular.

1 26. (Unchanged) An apparatus for efficiently deflecting light from an  
2 optical fiber around a corner, comprising:  
3 a first port adapted to be coupled to said optical fiber and to receive light with  
4 divergence angles of less than 90 degrees from the axis of said optical fiber;  
5 a non-imaging optical waveguide, connected to said first port, and adapted to  
6 direct light around said corner;  
7 a second port connected to said non-imaging optical waveguide; and  
8 wherein said first and second ports are circular.

1 27. (Unchanged) An apparatus comprising:  
2 a first optical fiber;  
3 a first port coupled to said first optical fiber;

4 a first non-imaging optical waveguide, connected to said first port, and adapted  
5 to receive light with divergence angles up to the maximum angle which can propagate  
6 with low loss in said first fiber optic around a 90 degree corner;

7 a second port connected to said non-imaging optical waveguide to direct light to  
8 a patient;

9 a second optical fiber;

10 a third port coupled to said second optical fiber;

11 a second non-imaging optical waveguide, connected to said third port, and  
12 adapted to direct light around said 90 degree corner to said second optical fiber with  
13 divergence angles up to the maximum that can propagate with low loss in said second  
14 optical fiber; and

15 a fourth port connected to said second non-imaging optical waveguide and  
16 configured to receive reflected light from said patient.

1 28. (Unchanged) An optical beam delivery system comprising at least one  
2 optical fiber and a non-imaging corner turner comprising:

3 a first port adapted to be coupled to said optical fiber and to receive light with  
4 divergence angles of less than 90 degrees from the axis of said optical fiber;

5 a non-imaging optical waveguide, connected to said first port, and adapted to  
6 direct light around said corner; and

7 a second port connected to said non-imaging optical waveguide.

1 29. (Unchanged) An optical beam delivery system comprising at least one  
2 optical fiber and a non-imaging corner turner according to claim 27.

1 30. (Unchanged) An optical beam delivery system according to claim 28, in  
2 which said non-imaging corner turner is integrally molded upon an end of said optical  
3 fiber.

1 31. (Unchanged) An optical beam delivery system according to claim 29, in  
2 which said non-imaging corner turner is integrally molded upon an end of said optical  
3 fiber.



1 32-47. Withdrawn.

2 48. (Unchanged) An apparatus for directing around a corner a beam of  
3 light, said beam having divergence half-angle of 90 degrees or less, while conserving étendue,  
4 comprising:

5 a first port adapted to receive said beam of light,  
6 a non-imaging light guide, connected to said port, and adapted by means of a  
7 bend to direct said beam of light around said corner,

8 a second port connected to said non-imaging light guide,  
9 wherein said non-imaging light guide comprises a first curved reflective  
10 segment extending along an outside of a turn around said corner, and

11 a second curved reflective segment extending around an inside of said turn  
12 around said corner,

13 wherein in any section parallel to a plane drawn through the bend, said first  
14 curved reflective segment appears as a first elliptical section and said second curved  
15 reflective segment appears as a second elliptical section.

1 49. (Unchanged) The apparatus of claim 48 wherein every section of said  
2 apparatus parallel to the plane of the bend is identical and wherein said non-imaging  
3 light guide further comprises an upper surface and a lower surface wherein said upper  
4 surface and said lower surface are planar reflective surfaces.

1 50. (Unchanged) The apparatus of claim 48, wherein in every section  
2 parallel to the plane of the bend, said first curved reflective segment is of such size as to  
3 contact said first port at an outer edge and said second curved reflective surface is of  
4 such size as to contact said first port at an inner edge.

1 ~~shei >~~ 51. (Unchanged) The apparatus of claim 2 wherein said non-imaging  
2 optical concentrator is a compound parabolic concentrator.

1 52. (Unchanged) The apparatus of claim 12 wherein said non-imaging  
2 optical concentrator is a compound parabolic concentrator.